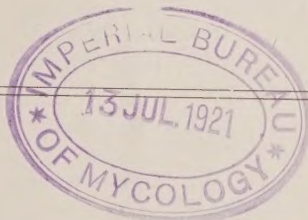


GEORGIA EXPERIMENT STATION

EXPERIMENT, GEORGIA



Irish Potato Spraying

By H. P. STUCKEY and B. B. HIGGINS

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Irish Potato Spraying

By H. B. STUCKEY and B. B. HIGGINS

Practically all reported experiments for ascertaining the value of spraying Irish potatoes have been carried on in Northern sections where conditions for potato growing are very different from conditions in Georgia and the neighboring states. The late blight, which is often so destructive in the North, is very rarely found here. Here also, with rare exception, only early maturing varieties are grown and their growing season is short in contrast with the slowly maturing varieties grown farther North which require healthy foliage for a much longer period. Hence, there has been some question as to whether we should, on the basis of these Northern experiments, advise growers in this region to follow a regular system of spraying year after year with Bordeaux mix-



Fig. 1. Sprayed plats on either side—unsprayed plat in center with foliage destroyed by potato beetles. Photo made May 22, 1916.

ture. With our early maturing and comparatively low yielding varieties, it has seemed doubtful whether the stimulative effect of the copper salts would increase the yield sufficiently to make their application profitable when no disease is present.

Early blight, caused by *Alternaria Solanis*, is, in this region, the only fungous parasite which attacks the potato foliage to any serious extent, and control of this pest must be the first consideration in the use of Bordeaux mixture.



Fig. 2. Leaves showing various stages in development of early blight.

The disease may be recognized usually by the rounded brown or grayish spots on the leaves, but this character is by no means constant. The spots often coalesce, killing large irregular areas or the entire leaf; and often infection spreads from the margin of the leaf very similarly to what is known as "tip burn." Such leaves, collected locally, when placed in a moist chamber always developed spores typically associated with the *Alternaria* blight. The general appearance of the diseased leaves is illustrated in figure 2.

Accurate data as to the loss from late blight are very meager and, excepting those herein reported, are entirely lacking for this region. Observations in this locality and reports from various sections of the state indicate that the disease is almost constantly present in the potato fields and the damage depends largely on weather conditions. For example, the disease was first noted in the experimental plats (1916) on May 25th, just six days after the first rain of the month. At this time only a few isolated leaves in the arsenate of lead plat showed infection and as successive rains were rather infrequent the damage was not serious. In 1915, however, the disease appeared earlier and, due to the more frequent rains, killed the foliage in a very short time.

With these considerations in view, spraying experiments, which we hope to continue through a number of years, were begun in 1915 to determine the value of Bordeaux for potatoes in this region. The results for the first two years of the tests are reported at this time for the use of those interested in this crop.

Soil Preparation and Fertilizers in 1915

The soil, a uniform, level, fertile, cecil clay loam, was well broken to the depth of from seven to eight inches, and was harrowed until it was in an excellent condition. The rows were laid off three and a half feet apart with an eight-inch shovel plow, leaving the furrows from four to five inches deep.

The fertilizer, made by mixing 16% acid phosphate and cotton seed meal in equal parts by weight, was applied in the drill at the rate of a thousand pounds per acre. After the fertilizer was applied, the shovel plow used for laying off the rows, was run again through the furrows so as to mix the fertilizer with the soil, thoroughly.

Planting and Cultivating

The potatoes were planted March 5th, just after the fertilizer was applied and mixed with the soil. The Irish Cobbler, a rather round, smooth, early maturing variety, was used. The potatoes were cut into from two to five pieces, according to the size and number of "eyes." Care was taken to leave one or more well developed "eyes" on each seed piece. Air slaked lime was sprinkled over the pieces of potatoes, as soon as they were cut, to absorb part of the moisture, and they were then taken at once to the field and planted. The pieces were dropped on the average of sixteen inches apart in the row and covered about four inches deep with a double-foot plow devised for the purpose.

As the seed tubers germinated and the young plants came through the soil, the cultivating was begun and was continued at regular intervals until the plants showed signs of maturity, when all culture was stopped.

The entire area was prepared and planted in the same way, at the same time, and to the same variety.

Spraying

The area was divided into four one-twelfth acre plats and sprayed twice during the season. The first application of spray was given on May 13th, and the second June 11th. The plats were sprayed both times with the same mixtures, which were as follows:

- Plat 1.** 4-5-50 Bordeaux mixture and $1\frac{1}{2}$ lbs. powdered arsenate of lead.
Plat 2. $1\frac{1}{2}$ lbs. powdered arsenate lead, 2 lbs. unslaked lime, and 50 gallons of water.
Plat 3. Check.
Plat 4. Duplicate of Plat 1.

Harvest in 1915

The 1915 crop of potatoes was harvested June 21st, with the following yields:

Plat Number	Lbs. Mkt. Potatoes.	Lbs. Small Potatoes.	Lbs. Decayed Potatoes.	Bu. per Acre Mkt. Potatoes.	Per Cent Gain.
1	322.50	20.00	.50	64.50	31.10
2	249.00	13.00	1.00	49.80	1.21
3	246.00	15.50	.50	49.20	.....
4	338.00	11.50	00	67.60	37.39



Fig. 3. Plat on right sprayed with Bordeaux and arsenate of lead, on left with arsenate of lead alone. 1915.

1916 Results

In 1916 the same land was used for this experiment as in 1915, together with an adjoining area of equal size. The soil preparation, the variety, the method of planting, and the culture given were the same as those in the 1915 experiments.

The area, which was twice that used in 1915, was divided into eight one-twelfth acre plats. One-half of each of the first four plats received the same fertilizer as that given in 1915—16% acid phosphate and cotton seed meal in equal parts by weight, applied broadcast at the rate of 1000 pounds per acre. The remaining halves of these four plats were not fertilized.

The entire area of the second four plats, which was the area used for the 1915 experiments, received, in addition to the acid phosphate and cotton seed meal mixture given the other plats, well-decomposed barn lot manure at the rate of ten tons per acre.

Spraying

The eight plants were sprayed twice during the season, according to the following schedule, the first application being given May 1st, and the second May 24th.

Plat 1. First spray: 3-4-50 Bordeaux mixture and 2 lbs. arsenate of lead paste.

Second spray: Same as that given in first spraying.

Plat 2. First spray: 2 lbs. of arsenate of lead paste, 3 lbs. of unslaked lime, and 50 gallons of water.

Second spray: Same as given in first spraying.

Plat 3. Check—not sprayed.

Plat 4. First spray: 2 lbs. of arsenate of lead paste, 3 lbs. unslaked lime, and 50 gallons of water.

Second spray: 3-4-50 Bordeaux mixture and 2 lbs. of arsenate of lead paste.

Plat 5. Duplicate of Plat 1.

Plat 6. Duplicate of Plat 2.

Plat 7. Duplicate of Plat 3.

Plat 8. Duplicate of Plat 4.

The potatoes were harvested June 19th and 20th, with the following yields:

Plat Number	Lbs. Mkt. Potatoes.	Lbs. Small Potatoes.	Total Bu. per Acre	Per Cent Gain Due to Spray.
1 and 5	168.75	19.00	37.50	216.52
2 and 6	156.75	10.00	33.35	182.62
3 and 7	43.00	16.00	11.80	check
4 and 8	180.75	15.00	39.20	232.20

Cost of Spraying in 1915

A fair estimate of the cost of materials used in the sprays for 1915 can be obtained by basing the cost of the ingredients on the following average prices:

Plats 1 and 4

Copper sulphate, 16 lbs. at 10c.....	\$1.60
Arsenate of lead (powd.) 6 lbs. at 18c.....	1.08
Lime (unslaked) 20 lbs. at $\frac{1}{2}$ c.....	.10
Labor and depreciation of outfit.....	.70
Water, 200 gallons.....	.00
Total.....	\$3.48

Plat 2

Arsenate of lead (powd.), 6 lbs. at 18c.....	\$1.08
Lime (unslaked), 8 lbs. at $\frac{1}{2}$ c.....	.04
Labor and depreciation of outfit.....	.50
Water, 200 gallons .....	.00
Total	\$1.62



Fig. 4. Yields from three plats: On the left sprayed twice with Bordeaux and arsenate of lead; in center sprayed twice with arsenate of lead alone; on right check not sprayed. 1916.

One hundred gallons an acre were used for each application of the spray mixtures. Therefore, the two hundred gallons for the two applications of Bordeaux and arsenate of lead would cost, approximately, \$3.48; and for the arsenate of lead application alone, \$1.62. The 1915 crop of potatoes was sold for 85 cents per bushel, and the gains and losses were computed on this basis.

Plat No.	Cost of Spraying	Increased bu. in yield	Value of Increase	Net Profit or Loss
1	\$3.48	15.30	13.00	\$ 9.52
2	1.62	.60	.51	—1.11
3 .....	.....	.....	.....	.....
4	3.48	18.40	15.64	12.16

Early blight was very destructive on unsprayed potatoes throughout this whole region in 1915, and was very severe in our check plat. Consequently we could not get any evidence as to the stimulative effect of the Bordeaux.

The loss of \$1.11 on the arsenate of lead sprayed plat may be explained by the fact that very soon after the plants of the check plat were practically defoliated by the potato beetles, early blight swept the plat sprayed with arsenate of lead as well as the check plat, thus putting the two on essentially the same footing. The plats sprayed with the Bordeaux mixture and arsenate of lead in 1915 were well protected from the attacks of the early blight and the potato beetles, which doubtless accounts for the increased yields of these plats over the arsenate of lead, plat, and the check plats.

Cost of Spraying in 1916

The cost of spray materials advanced in price considerably between the spraying season of 1915 and that of 1916. This made the cost of spraying proportionately greater. The cost of the ingredients used in the spray mixtures for 1916 was as follows:

Plats 1 and 5

Copper sulphate, 12 lbs. at 27c.....	\$ 3.24
Arsenate of lead paste, 8 lbs. at 16c.....	1.28
Lime (unslaked) 16 lbs. at $\frac{1}{2}$ c.....	.08
Labor and depreciation of outfit.....	.70
Water, 200 gallons.....	.00
Total	\$ 5.30

Plats 2 and 6

Arsenate of lead, 8 lbs. at 16c.....	\$ 1.28
Lime (unslaked) 16 lbs. at $\frac{1}{2}$ c.....	.08
Labor and depreciation of outfit.....	.50
Water, 200 gallons.....	.00
Total	\$ 1.86

Plats 3 and 7, Checks—not sprayed

Plats 4 and 8.

Copper sulphate, 6 lbs. at 27c.....	\$ 1.62
Arsenate of lead, 8 lbs. at 16c.....	1.28
Lime (unslaked), 14 lbs. at $\frac{1}{2}$ c.....	.07
Labor and depreciation of outfit.....	.60
Water, 200 gallons.....	.00
Total	\$ 3.57

One hundred gallons an acre were used in 1916, the same quantity that was used in 1915. The two hundred gallons for the two applications of Bordeaux mixture and arsenate of lead paste cost approximately \$5.30; for the two applications of arsenate of lead, \$1.86, and for the application of arsenate of lead, followed by an application of Bordeaux mixture with arsenate of lead added, \$3.57. The potatoes in 1916 were sold for \$1.50 per bushel, and the gains and losses of the different plats were computed on this basis.

Plats	Cost of Spraying	Increase Bu. in Yield	Value of Increase	Net Profit
1 and 5.....	\$5.30	25.70	38.55	\$33.25
2 and 6.....	1.86	21.55	32.32	30.46
3 and 7.....	.....	.....	.....	.....
4 and 8.....	3.57	27.40	41.10	37.53

At first glance some of the results for 1916 appear rather difficult to interpret. Although all plats sprayed with Bordeaux gave higher yields than those sprayed with arsenate of lead alone, we find those, on which Bordeaux was omitted at first spraying, yielding slightly more than those receiving two applications. This increase was so small, however, that it should in all probability be attributed to experimental error and to the fact that several plants in one of the latter plats were killed by Rhizoctonia. We are forced to the conclusion, however, that under the conditions prevailing here this year, the first application of Bordeaux might very well be omitted.

In 1915 the blight appeared early in May, and soon killed the foliage on all plats not sprayed with Bordeaux; but in 1916, due to the very low humidity, the disease did not appear until May 25th, and did not cause any extensive loss of foliage until the vines were mature and beginning to die normally.

A little study of the accompanying rainfall data will also help in understanding the results.

Rainfall During Irish Potato Growing Seasons of 1915 and 1916

Date	Rainfall In.		Date	Rainfall In.		Date	Rainfall In.	
	1915	1916		1915	1916		1915	1916
April 2	0.14	0.13	May 1	trace	....	June 1	1.62	....
3	0.08	0.14	7	2.70	....	2	0.76	....
7	....	1.02	8	0.29	....	4	....	0.30
17	....	0.25	11	1.46	....	6	0.06	0.05
21	....	0.36	12	0.37	....	12	1.54	0.64
28	0.50	....	17	trace	....	13	0.10	....
29	0.37	....	19	trace	trace	14	trace	0.21
			22	....	0.23	16	0.03	1.39
Totals	1.09	1.90	23	....	0.77	17	0.03	....
			26	trace	....		
			27	0.26	....	Totals	4.14	2.59
			28	0.56	....		
			30	....	0.10			
			31	0.82	....		
			Totals	6.46	1.10			

Evidently the extreme drought from April 21st to May 22nd was the principal limiting factor of the yield for all except check plats where potato beetles destroyed all foliage before the tubers were well formed. The supply of water to the roots of the plants was so low as to almost eliminate the advantage of increased foliage efficiency, due to protection from disease and to stimulus of copper salts. This conclusion is further supported by the fact that in some fertilizer tests on the same soil a mixture of 500 pounds of acid phosphate and 500 pounds of cottonseed meal gave an average increase of only $3\frac{3}{4}$ bushels per acre.

Conclusions: Naturally, few very definite, general conclusions can be drawn from the two years' tests; but the results indicate that early blight may be very destructive, and during some seasons spraying with Bordeaux as well as arsenate of lead (or other insecticide) is necessary for successful potato production in this region.

Our experience indicates also that two applications of mixed Bordeaux and arsenate of lead are sufficient for controlling both early blight and potato beetles on our early maturing varieties, and that the first application should be made when plants are about six to eight inches high (usually about second week in May), and the second about three weeks later.

Bordeaux Mixture for Spraying Irish Potatoes

We have found that the following formula is very satisfactory for spraying Irish potatoes against the early blight:

Copper sulphate (blue stone)	4 pounds
Lime (unslaked)	5 pounds
Water	50 gallons

Dissolve the copper sulphate in a small quantity of hot water, and make it up to 25 gallons with water. Slake the lime in another vessel, and make it up to 25 gallons with water as soon as the lime is well slaked. Pour the two solutions into a third vessel at the same time, taking care that neither of the solutions be poured in faster than the other, and stir well. If arsenate of lead is to be applied with the Bordeaux mixture, it should be

made into a thin paste with water, and added after the Bordeaux mixture is made. Bordeaux mixture, as well as other spray solutions, should be strained or filtered as it is put into the spray tank, so as to prevent clogging the spray nozzles.

As copper sulphate solutions injure iron or tin, they should be prepared in stone or wooden vessels. Syrup or vinegar barrels sawed into halves make very good tubs for this purpose.